

I Claim:

1. A fibre channel switching fabric for connecting multiple attached devices comprising:

multiple port control modules, the port control modules being adapted for communication with the attached devices, the port control module functioning to build a route request and read a route response,

a router module, the router module being connected to the port control modules by a route request connection and by a separate route response connection, and

a switch core, the switch core being connected to the port control modules.

2. The fibre channel switching fabric of claim 1 for connecting multiple attached devices further including a fabric control module connected to the router module and port control modules.

3. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein there is one port control module for each attached device.

4. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein at least one port control module is attached to a arbitrated loop having multiple attached devices.

5. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein the port control module further serves to modify frames.

6. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein the port control module modifies frames to fabric frame busy (F_BSY).

7. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein the port control module modifies frames to fabric frame reject (F_RJT).

5 8. The fibre channel switching fabric of claim 1 wherein the port control module further functions to discard frames.

9. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein the port control module performs frame validation.

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10. The fibre channel switching fabric of claim 9 for connecting multiple attached devices wherein the frame validation includes parity error validation.

11. The fibre channel switching fabric of claim 9 for connecting multiple attached devices wherein the frame validation includes invalid transmit word correction.

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12. The fibre channel switching fabric of claim 9 for connecting multiple attached devices wherein the frame validation detects frame size error.

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13. The fibre channel switching fabric of claim 9 for connecting multiple attached devices wherein the port control module further performs frame connection.

14. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein the fabric is connected in a direct fabric attached topology.

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15. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein the fabric is connected in an arbitrated loop attached topology.

16. The fibre channel switching fabric of claim 1 for connecting multiple attached devices wherein the attached devices include fibre channel compliant devices

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selected from the group comprising: a mainframe, a workstation, a personal computer, a storage device and a disk array.

17. The fibre channel switching fabric of claim 1 for connecting multiple
5 attached devices wherein the attached devices include a second fabric.

18. The fibre channel switching fabric of claim 1 for connecting multiple
attached devices wherein the switch core comprises a full crossbar.

10 19. The fibre channel switching fabric of claim 1 for connecting multiple
attached devices further including a bridge module.

20. The fibre channel switching fabric of claim 1 for connecting multiple
15 attached devices further including a hub module.

21. The fibre channel switching fabric of claim 1 for connecting multiple
attached devices wherein the attached devices are connected to the fabric by a serial
link.

20 22. The fibre channel switching fabric of claim 21 for connecting multiple
attached devices wherein the link is a copper connection.

23. The fibre channel switching fabric of claim 21 for connecting multiple
25 attached devices wherein the link is a fiber optic connection.

24. The fibre channel switching fabric of claim 1 for connecting multiple
attached devices wherein the fabric receives fibre channel frames of at least one
gigahertz.

30 25. The fibre channel switching fabric of claim 1 for connecting multiple
attached devices which supports Class 1 service.

26. The fibre channel switching fabric of claim 1 for connecting multiple attached devices which supports Class 2 service.

5 27. The fibre channel switching fabric of claim 1 for connecting multiple attached devices which supports Class 3 service.

28. The fibre channel switching fabric of claim 1 for connecting multiple attached devices which supports each of Class 1, Class 2 and Class 3 service.

10 29. The fibre channel switching fabric of claim 28 for connecting multiple attached devices which further supports intermix service.

30. A method for servicing route requests from multiple attached devices where the routing is subject to blocked and unblocked conditions, the method comprising the steps of:

15 servicing a route request which is not blocked, and
saving a blocked route request in hardware and servicing that request if
the route changes from a blocked to an unblocked condition prior to the
20 expiration of a specified time period.

31. The method of claim 30 wherein the saved route request includes sufficient information to regenerate the route request once the blocked condition is cleared.

25 32. The method of claim 31 wherein the saved information regarding the blocked route request includes the requesting port control module port.

30 33. The method of claim 31 wherein the saved information regarding the blocked route request includes a matched destination port control module port.

34. The method of claim 31 wherein the saved information regarding the blocked route request contains the blocking condition.

35. The method of claim 31 wherein the saved information regarding the blocked route request includes the indication of an end of frame delimiter being
5 received by the requesting port control module port.

36. The method of claim 31 wherein the saved information regarding the blocked route request includes a delimiter in the incoming frame.

10 37. The method of claim 31 wherein the saved information regarding the blocked route request includes whether there was an address match.

38. The method of claim 31 wherein the saved information regarding the blocked route request includes whether to route to the fabric port control module.

15 39. The method of claim 31 wherein the saved information regarding the blocked route request includes whether a fabric reject frame (F_RJT) is to be generated.

20 40. The method of claim 31 wherein the saved information regarding the blocked route request includes whether a fabric busy frame (F_BSY) is to be generated.

25 41. A fibre channel fabric for connecting multiple attached devices supporting connection based service and connectionless based service between attached devices, comprising:

multiple port control modules, the port control module being adapted for connection to an attached device,

30 a router, the router being in communication with the port control modules to receive route requests and to generate route responses and to provide the route responses to the port control modules, the port control modules being

connected to the router by separate route request connections and route response connections, and

a single switch core for support of connection based service between attached devices and connectionless based service between attached devices.

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42. The fibre channel fabric of claim 41 for connecting multiple attached devices further including a fabric control, the fabric control in communication with the port control modules.

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43. The fibre channel fabric for connecting multiple attached devices of claim 41 wherein the single switch core is a non-blocking switch core.

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44. The fibre channel fabric for connecting multiple attached devices of claim 41 wherein the dedicated connection is maintained in the switch core until a removal request is received.

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45. A fibre channel fabric for connecting multiple attached devices supporting connection based service and connectionless based service between attached devices, comprising:

multiple port control modules, the port control module being adapted for connection to an attached device,

a router, the router being in communication with the port control modules to receive route requests and to generate route responses and to provide the route responses to the port control modules, the router constructing a route in two microseconds or less, and

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a single switch core for support of connection bases service between attached devices and connectionless based service between attached devices.

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46. A fibre channel fabric for connecting multiple attached devices supporting connection based service and connectionless based service between attached devices, comprising:

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multiple port control modules, the port control module being adapted for connection to an attached device,

a router, the router being in communication with the port control modules to receive route requests and to generate route responses and to provide the route responses to the port control modules, the router including multiple state machines which result in pipelined operation for handling route requests and route responses, and

a single switch core for support of connection bases service between attached devices and connectionless based service between attached devices.

47. A fibre channel switching fabric for connecting multiple attached devices comprising:

multiple port control modules, the port control modules including a connection for communication with attached devices, a route request generator, and a route request response receiver,

a router, the router including an input for receiving the output of the route request generator of the port control modules, an output for sending a route request response to the route request response receiver in the port control module, a hardware finite state machine to receive the route request, and a hardware finite state machine to provide the route response, the router further including a route determination system which determines a route within a single clock cycle of the system, and

a switch for selective interconnect of the port control modules.

48. The fibre channel switching fabric of claim 47 for connecting multiple attached devices wherein the router control includes a hardware finite state machine.

49. The fibre channel switching fabric of claim 47 for connecting multiple attached devices wherein the single clock cycle is 30 nanoseconds or less.

50. An improved port control module for use in a fibre channel switching fabric comprising:

- an input/output port for connection to a link,
- an encoder/decoder in communication with the input/output port, and
- a buffer,
- the improvement comprising the inclusion of buffer overrun prevention logic between the encoder/decoder and the buffer.

51. The improved port control module for use in a fibre channel switching fabric of claim 50 wherein the buffer is a first-in, first-out buffer.

52. The improved port control module for use in a fibre channel switching fabric of claim 50 where the buffer overrun prevention logic sets tag bits to a unique value indicative of an overrun conditions.

53. A method for control of an input buffer, where the input buffer is adapted to receive a stream of data at a rate which is not subject to control by the buffer, comprising the steps of:

- receiving the data,
- placing the data in the buffer,
- monitoring for an overflow condition,
- and if an overflow condition is detected, including a detectable signal in association with the data, and
- providing the data from the buffer and the detectable signal to subsequent devices.

54. The method of claim 53 for control of an input buffer, the detectable condition comprising tag bits.

55. The method of claim 54 for control of an input buffer wherein the tag bits are set to a unique condition.

56. A fibre channel switching fabric for connecting multiple attached devices, comprising:

multiple port control modules, the modules being adapted for communication over links to the attached devices,

a router connected to the port control modules, the router including:

a port control route request state machine,

a port control route response state machine, and

a route determination module,

the port control route request state machine, the route determination module and the port control route response state machine connected in a serial manner for pipeline operation, and

a switch connected to the port control modules and the router.

57. The fibre channel switching fabric of claim 56 for connecting multiple attached devices further including a fabric control system connected to the port control modules and router.

58. The fibre channel switching fabric of claim 56 for connecting multiple attached devices further including a router control state machine.

59. The fibre channel switching fabric of claim 56 for connecting multiple attached devices wherein the port control route request state machine includes a round-robin arbitration selection unit which is connected to the port control modules.

60. The fibre channel switching fabric of claim 59 for connecting multiple attached devices wherein each port control module is separately connected to the round-robin arbitration selection unit.

61. The fibre channel switching fabric of claim 60 for connecting multiple attached devices wherein the port control modules are connected to the port control

route request state machine by a shared route request data channel and separate route request connections.

62. The fibre channel switching fabric of claim 61 for connecting multiple attached devices wherein the selection unit and the route request state machine provide a signal to the port control module which has been selected.

63. A communication system for connecting multiple attached devices comprising:

- multiple port control modules,
- a router connected to the port control modules,
- a switch core connected to the router and the port control modules, the router providing selective interconnection between the port control modules, and
- an arbitrated loop adapted to connect to multiple attached devices, the arbitrated loop being connected to a port control module.

64. A method for handling blocked route requests in a communications system, where a route request includes at least a destination address, a source address and priority information, comprising the steps of:

- receiving the route request,
- determining if the route can be completed,
- if the route cannot be completed, storing the route request,
- determining when to effectuate the route indicated by the route request and based upon the priority and state information, and
- completing the route when indicated by the time condition and the priority condition.

65. The method for handling blocked route requests in a communication system of claim 64 wherein the priority information is from the group comprising: Class 1, Class 2 and Class 3 service.

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